

## EFFECT OF GENDER AND BMI ON MAXIMUM URINE HOLDING CAPACITY OF THE URINARY BLADDER

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### **Abstract:**

*Background and Objectives:* Micturition reflex is long been taught as an interplay of autonomic and somatic nervous system. This reflex is expected to vary with bladder-habits, gender and BMI differences but no study supports this theory sufficiently. The objective of this study is to provide evidence for variation in bladder capacity to hold urine by bladder-habits, gender and BMI.

*Methods:* A total of 69 1<sup>st</sup> year dentistry students (20 males & 49 females) who consented were asked to empty their bladder naturally followed by drinking measured amounts of mineral water in glass-beaker to the level that they would not be able to hold urine any further. They were advised to note down all their feelings during that process as mentioned in the response form. They also accounted their usual bladder-habit of postponing the visit and lastly expressed that they passed urine in presence of favorable or unfavorable condition.

*Results:* Male students due to comparatively greater mean height and weight had significantly higher maximum capacity of bladder to hold urine independent of BMI. Likewise there was gender-wise significant difference in appearance of 1<sup>st</sup> desire to micturate, discomfort and pain in terms of filling capacity of bladder. Micturition-postponing-behavior did not affect significantly the maximum capacity to hold urine but played significant role on voluntary control of micturition under unfavorable circumstances.

*Conclusions:* Bladder capacity and voluntary control varies with gender and accommodating behavior respectively. This study may help in establishing a data base in our study population and may add to scientific knowledge.

*Key words:* Micturition reflex, behavior, BMI, Gender.

### **INTRODUCTION**

Bladder health can be maintained by promoting healthy bladder habits and behaviors.<sup>1</sup> Urodynamics of micturition are highly affected by water consumption and urine production rate. However, the diurnal urine volume instead of urinary frequency is considered to be more affected by fluid intake.<sup>2,3</sup> There are certain physiological and behavioral differences as regards the control of bladder, thus influencing voiding and incontinence. The physiology underlying gender differences regarding bladder behaviour is not well understood, thus highlighting the need of further research in this area.<sup>4-6</sup> It has been shown that water consumption and urine production show a gender specific pattern.<sup>6</sup> In addition, females tend to empty their bladder without sufficient relaxation of pelvic floor which may lead to bladder dysfunction more commonly in females in subsequent stages of life.<sup>5</sup> There are gender related differences in the position and shape of bladder. Female bladder is not only placed more caudally but also it's less compact in horizontal plane as compared to male

bladder. However, gender actually has no direct influence on bladder capacity. Bladder capacity and therefore urine output rate remain the same in both genders, under normal physiological conditions.<sup>7,8</sup>

Mechanism of sex differences in urine holding capacity needs to be explored further as it can provide the basis for the pathophysiology of lower urinary tract symptoms (LUTS). Different bladder emptying rates have been seen even in full term male and female newborns, showing a difference in urodynamics right from the beginning.<sup>9,10</sup> Anatomically, a difference in the smooth muscle arrangement in bladder wall as well as in proximal urethra has been noted in case of females. A circular smooth muscle layer surrounding the longitudinal muscle layer is found in proximal urethra but was found absent in bladder neck in a study on Japanese women. Similarly, another study has shown some difference to exist not only in the arrangement but also in the innervation of smooth muscles in males and females in the proximal urethra and showing the presence of a proximal pre-prostatic urethral sphincter in

males.<sup>11,12</sup>

Very little is known about the behavior of bladder under different circumstances especially if we consider the effect of gender and BMI.<sup>1,4,8,9</sup> As mentioned in Guyton text book of medical physiology the higher centers have inhibitory control over external urethral sphincter by pudendal nerve. Even when the micturition reflex has initiated, higher center inhibition may come into action under unfavorable circumstances like in case of in-availability of a clean and vacant toilet.<sup>13</sup> Practical demonstration of physiological mechanisms (like micturition reflex) and establishment of data base in our population is grossly lacking. So, the objective of our study was to identify the influence of gender, BMI and circumstances on bladder behavior as it can produce a variety of effects in subsequent life.

**MATERIAL AND METHODS**

This was a cross sectional comparative study conducted on 69 first year dental undergraduate students (20 males and 49 females) at University College of Medicine and Dentistry, The University of Lahore, after taking their written informed consent. The students with urinary problems were excluded from the study after medical examination. They were advised to refrain from fluid intake since morning (4 hours of conduction of experiment). Then they were asked to empty their bladders at the beginning. Their height and weight was recorded and BMI calculated. Thereafter, they were advised to drink measured quantity of water using graduated glass beakers. They noted the volume of water intake in milliliters at which they developed the first sensation or urge for micturition; abdominal fullness; pain in holding urine and finally, they were asked also to note at what capacity of water intake, they decided to pass urine. Meanwhile, their bladder habits of postponing the visit were also accounted for. It was also mentioned that they finally passed urine or not in pre-

sence of favorable or unfavorable toilet conditions. The duration of this study was 3 hours.

**RESULTS**

In our study, it was noted that male students had a greater capacity to hold urine, but this urine holding capacity cannot be attributed to increased BMI. Irrespective of the micturition postponing behavior, the maximum capacity to hold urine, as depicted by intense desire to micturate and lower abdominal pain, cannot be altered although voluntary control can play its role under unfavourable conditions in terms of availability of place (vacant toilet) and its hygiene. Bladder capacity increases significantly in male gender and there is late onset of the desire to evacuate along with development of discomfort & pain (Table 1).

Body weight and height did not affect the maximum capacity of bladder significantly. Similarly, BMI (independent of gender) did not affect maximum capacity of bladder to hold urine. Likewise behavior to postpone micturition did not affect the maximum bladder capacity. Subjects with micturition postponing behaviors significantly held urine (p 0.02) until favorable conditions were available (Figure 1).

**DISCUSSION**

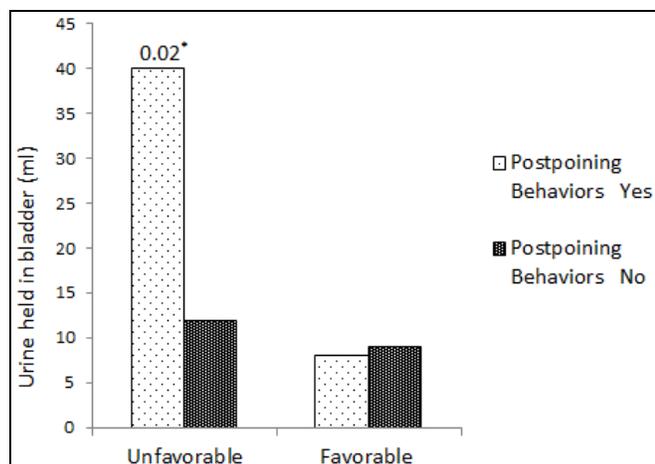
This is one of the pioneer studies in the region to explore the bladder behavior under the effect of gender, BMI and unfavorable circumstances. There is little awareness in this regard as compared to the magnitude of issue.<sup>1,5,7,14</sup> A similar study conducted on Japanese women showed the existence of a ventrally localized structure instead of a complete circular smooth muscle layer around the longitudinal layer.<sup>11</sup>

Similarly, another anatomical study conducted on smooth muscle of developing human urinary bladder showed a gender related difference in the arrangement and innervation of smooth muscles which may play a

**Table 1:** Comparison of participants by gender.

	Males (n = 20)	Female (n = 49)	P-value
Weight (kg)	72.20 ± 11.99	59.06 ± 13.54	< 0.001*
Height (cm)	174.85 ± 7.69	157.79 ± 6.17	< 0.001*
BMI	24.38 ± 4.92	23.84 ± 5.44	0.706
1 <sup>st</sup> sensation of fullness (ml)	487.50 ± 170.04	585.71 ± 259.80	0.124
1 <sup>st</sup> desire to micturate (ml)	1230.00 ± 473.62	944.90 ± 300.74	0.019*
Feeling of discomfort in holding urine (ml)	1560.00 ± 426.00	1216.33± 305.74	0.003*
Sensation of pain in holding urine (ml)	1850.00 ± 502.10	1473.47 ± 307.39	0.004*
Maximum bladder capacity to hold urine (ml)	2235.00 ± 672.21	1635.71 ± 366.00	0.001*

\*Statistically significant difference (P < 0.05; Student’s t-test)



**Fig. 1:** Variable retention of urine in subjects with or without micturition postponing behavior under favorable and unfavorable toilet conditions ( $p$ -value 0.02\*).

role in different bladder behavior under different conditions in both the sexes.<sup>12</sup> Many other studies carried out in both humans and animals showed a variation in the urine production and micturition characteristics in males and females.<sup>2,5-9</sup>

It is **concluded** that the current study suggested that bladder capacity itself is not affected by gender or body mass index. However, there is an effect of unfavorable circumstances on urine holding capacity by bladder (accommodation behavior) under voluntary control. Moreover, despite of the fact that bladder size is not affected by gender, males had an urge and complaint of abdominal pain and tenderness due to filling of bladder much later than females. This can be attributed to anatomical difference between male and female's smooth muscle of bladder.

## RECOMMENDATIONS

This study may help in establishing a data base in our study population and may add to scientific knowledge. The data presented was based on a relatively small sample. We would like to conduct similar gender based and age-related study on larger sample size for more reliability of results. Because of the fact that healthy bladder habits lead to a healthy lower urinary tract and prevents the development of LUTS, it is highly recommended that further studies are carried out to study the bladder behavior under different circumstances.

## Conflict of Interest

The authors do not have any conflict of interest.

## Author's Contribution

MQJ: Conducted the research, improve the diagram and final draft of manuscript. SS, QM and ZN: Prepa-

red the initial draft of manuscript. WL: Applied statistics and interpreted the results. SM: Conceive the idea, evaluated the results and improve the final draft of the manuscript.

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